Effects of literacy on semantic verbal fluency in an immigrant population

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ABSTRACT

Objective: A significant impact of limited schooling and illiteracy has been found on numerous neuropsychological tests, which may partly be due to the ecological relevance of the tests in the context of illiteracy. The aims of this study were to compare the performance of illiterate and literate immigrants on two semantic criteria for the verbal fluency test, and examine the influence of acculturation on test performances.

Method: Performances of 20 cognitively unimpaired illiterate and 21 literate Turkish immigrants aged ≥50 years were compared on an animal and supermarket criterion for the semantic verbal fluency test. Also, the influence of acculturation on test performances was examined.

Results: Significantly poorer performance of the illiterate compared to the literate group was found for the animal criterion, whereas no differences were found for the supermarket criterion that was considered more ecologically relevant for illiterate individuals. A significant interaction effect was found between the semantic criteria and literacy group, which was mainly related to a large effect of semantic criteria within the illiterate group. Adjusting for years of residence in Denmark and acculturation score did not affect this interaction effect.

Conclusions: Overall, our results are in line with previous studies comparing semantic fluency in illiterate and literate individuals. The results lend further support to the strong associations between literacy, semantic verbal fluency performance and ecological relevance of the semantic criterion and extend previous findings to immigrants with different cultural experiences related to the acculturation process.

Introduction

Assessment of verbal fluency is an integral part of most neuropsychological evaluations and is frequently assessed by different versions of phonemic and semantic verbal fluency tests requiring production of words beginning with a specific letter or from a given semantic category within a given time interval. Although several versions exist, the most common version of semantic verbal fluency involves production animal names within a one-minute interval (Brucki & Rocha, 2004; Mitrushina, Boone, & da Silva, 2005;
The test is popular due to its brevity, ease of administration, and well-established sensitivity to cognitive impairment from a wide range of aetiologies, including traumatic brain injury, neurodegenerative diseases and psychiatric disorders (Strauss et al., 2006). Although the test can be regarded as rather simple, it taps a number of cognitive processes including executive functions, mental processing speed, language functions and semantic memory (Strauss et al., 2006). Left frontal structures, including the dorsolateral prefrontal cortex, inferior frontal cortex (Broca’s area) and anterior cingulate gyrus, are commonly viewed as the primary neural substrates involved in both phonemic and semantic word generation. In addition, semantic fluency has been proposed to be more dependent on temporal lobe structures reflecting its reliance on access to semantic knowledge (Mitrushina et al., 2005; Strauss et al., 2006).

There is a growing body of literature investigating the association between illiteracy and neuropsychological test performance. According to the Revised Recommendation concerning the International Standardization of Educational Statistics, an illiterate person is a person who cannot “with understanding both read and write a short simple statement related to his/her everyday life” (UNESCO, 1978). The impact of illiteracy is not restricted to the language domain but affects function within a range of cognitive domains. Thus, a significant impact of illiteracy has repeatedly been reported on the mini-mental state examination (MMSE) (Brucki, Nitrini, Caramelli, Bertolucci, & Okamoto, 2003; Laks et al., 2003; Nielsen, Vogel, Gade, & Waldemar, 2012; Ostrosky-Solis, Lopez-Arango, & Ardila, 2000), learning and recall of word lists (Ardila, Rosselli, & Rosas, 1989; Folia & Kosmidis, 2003; Nitrini et al., 2004), copying tests (Ardila et al., 1989; Brickman, Cabo, & Manly, 2006; Dansilio & Charamelo, 2005; Hong et al., 2011; Manly et al., 1999; Nielsen & Jorgensen, 2013), complex motor tests (Nitrini, Caramelli, Herrera, Charchat-Fichman, & Porto, 2005; Ostrosky-Solis et al., 1999; Rosselli et al., 1990), and phonemic and semantic fluency tests (Brucki & Rocha, 2004; da Silva, Petersson, Faisca, Ingvar, & Reis, 2004; Fichman et al., 2009; Kosmidis, Tsapkini, Folia, Vlahou, & Kiosseoglou, 2004; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Rosselli et al., 1990; Youn et al., 2011). Although an impact of illiteracy has also been described on other tests within a wide range of cognitive domains, these have been less studied (see Ardila et al. (2010) for a review). Low scores on neuropsychological tests in illiterate people have generally been proposed to reflect differences in learning opportunities of the specific abilities tested, as well as lacking familiarity with test materials and procedures. Illiterate people are usually not test wise; that is, they are not used to being tested and may not know how to behave in a test situation. Also, illiteracy may act as a surrogate for other factors affecting neuropsychological test performance, e.g., low socioeconomic status and lifestyle-related risk factors associated with this (Ardila et al., 2010; Nielsen & Jorgensen, 2013).

Studies investigating the association between illiteracy and verbal fluency have been conducted in several countries in South- and Central America (Brucki & Rocha, 2004; Fichman et al., 2009; Ostrosky-Solis et al., 1999; Rosselli et al., 1990), South Europe (da Silva et al., 2004; Kosmidis et al., 2004), Asia (Mathuranath et al., 2003; Youn et al., 2011) as well as ethnic minority groups in the USA (Manly et al., 1999). Generally, these studies report significantly better performance on semantic compared to phonemic fluency.
(Kosmidis et al., 2004; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Rosselli et al., 1990), which has proved to be very challenging for illiterate individuals. While illiterate people aged 50 years or more are typically able to name 10–13 animals in one minute (Brucki & Rocha, 2004; da Silva et al., 2004; Fichman et al., 2009; Kosmidis et al., 2004; Manly et al., 1999; Ostrosky-Solis et al., 1999; Rosselli et al., 1990; Youn et al., 2011), they typically produce no more than 2–4 words beginning with a specific letter (Kosmidis et al., 2004; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Rosselli et al., 1990). This is most likely due to difficulties with explicit processing of phonological information, which appears to be a skill related to knowledge of grapheme-phoneme correspondence acquired with literacy or formal schooling (Kosmidis et al., 2004).

Studies comparing verbal fluency in literate and illiterate populations have generally compared semantic fluency using an animal criterion although other criteria have also been used. Generally, these studies report poorer semantic fluency performance in uneducated illiterate people compared to educated literate people (Brucki & Rocha, 2004; Fichman et al., 2009; Kosmidis et al., 2004; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Youn et al., 2011). Whether this is due to the effects of schooling rather than literacy per se, however, is not fully resolved. For instance, a US study comparing Hispanic and African American literate and illiterate groups matched by education, age, gender and functional status did not find any differences in semantic fluency performance (Manly et al., 1999). Also, a Portuguese study found poorer performance in illiterate people when an animal criterion was used, but not on a supermarket criterion (da Silva et al., 2004) due to a higher ecological relevance this criterion in the context of illiteracy.

To our knowledge, the study by da Silva et al. (2004) is the only study that has investigated the association between literacy and ecological relevance of the semantic criterion used for semantic verbal fluency. However, the study was conducted in native Portuguese women with similar socio-cultural backgrounds except for schooling, and the reported associations may not be readily applicable to migrants whose performances may be influenced by different cultural experiences related to the acculturation process after settling in a new country.

Acculturation refers to the complex process whereby the attitudes and/or behaviors of individuals from one culture are modified as a result of contact with a different culture (Dela Cruz, Padilla, & Agustin, 2000), and can be used to assess the association of cultural experience with neuropsychological test performance among people with lifestyles that are very dissimilar to the majority culture. Although we have previously found visuoconstructional abilities in illiterate Turkish immigrants to be unrelated to level of Danish acculturation (Nielsen & Jorgensen, 2013), most US studies investigating the effects of acculturation on neuropsychological test performance in ethnic and linguistic minority groups find that higher levels of acculturation to US mainstream culture is associated with better neuropsychological test performance on a number of neuropsychological tests, including phonetic and semantic fluency (Arentoft et al., 2012; Boone, Victor, Wen, Razani, & Ponton, 2007; Manly, Byrd, Touradji, & Stern, 2004). Although illiteracy will certainly affect the acculturation process, in particular when acquisition of a new language is essential for interacting with the new culture, literacy is not a prerequisite for acculturation, and it is unknown whether cultural experiences related to acculturation may affect
the interaction between literacy and ecological relevance of the semantic criteria used for semantic verbal fluency.

Illiteracy is generally limited among the elderly in Western and Northern Europe. However, many older people from ethnic minorities have migrated from low- and middle-income countries and have little or no formal schooling. Although the pattern of immigration and the history of ethnic minorities are heterogeneous, the Turkish immigrant population constitutes the single largest ethnic minority in Europe. Illiteracy is widespread among elderly Turkish immigrants, in particular among women due to cultural differences in women’s access to formal schooling in the first part of the 20th century (Nielsen & Jorgensen, 2013).

The aims of this study were to compare the performance of cognitively healthy illiterate and literate Turkish immigrants on an animal and supermarket criterion for the semantic verbal fluency test, and to examine the influence of acculturation on test performances. The choice of a Turkish immigrant population was solely based on availability. We believe similar results could have been obtained in other immigrant groups with the same demographic characteristics.

Method

Subjects

The study sample was derived from a study investigating the cross-cultural applicability of a number of neuropsychological tests in cognitively unimpaired Turkish immigrants in Denmark aged ≥50 years that was conducted between September 2009 and December 2010 (Nielsen & Jorgensen, 2013; Nielsen, Vogel, & Waldemar, 2012; Nielsen, Vogel, Gade, et al., 2012). Contact information on a random sample Turkish elderly residing in the greater Copenhagen area was obtained from the Danish Civil Registration System (DCRS) (Pedersen, Gotzsche, Moller, & Mortensen, 2006), in which individual demographic data, including age, gender, current address, and country of residence before immigration is recorded. Based on addresses retrieved from the DCRS, participants were recruited through personal letters of invitation and follow-up phone calls by bilingual research assistants. Participants were assessed in their home or another suitable location, or in the Danish Dementia Research Center at Righospitalet, University of Copenhagen, depending on their preference. Specifics of the recruitment procedures have been described in detail elsewhere (Nielsen, Vogel, Gade, et al., 2012).

Subjects reporting significant memory problems, psychiatric or neurological disorders, including stroke, traumatic head injury or substance abuse, or scoring ≥10/15 points on the 5/15-item Geriatric Depression Scale (Weeks, McGann, Michaels, & Penninx, 2003) or ≤23/30 points on the Rowland Universal Dementia Assessment Scale (RUDAS) (Storey, Rowland, Basic, Conforti, & Dickson, 2004) were excluded. The RUDAS is a brief cognitive screening test that has been developed specifically for multicultural populations. It has six items that assess body orientation, praxis (alternating hand movements), drawing (copying of a cube), judgment (in relation to crossing a road), memory (grocery recall) and language (animal fluency), and has previously been found to have good psychometric properties in illiterate populations (Nielsen et al., 2013) and
be suitable Turkish immigrants with varying levels of schooling (Nielsen, Vogel, Gade, et al., 2012).

Data on formal schooling and literacy were collected in the demographic section of a structured interview and were confirmed in the reading and writing items of the MMSE. Unschooled illiterate subjects were defined as subjects who (a) had 0 years of schooling, (b) reported to be illiterate, and (c) were unable to read the command “close your eyes” and write a sentence properly (in either Turkish or Danish) on the MMSE. Schooled literate subjects were defined as subjects who (a) had ≥1 years of schooling, (b) reported to be literate, and (c) were able to read the command “close your eyes” and write a sentence properly (in either Turkish or Danish) on the MMSE.

Of the 83 subjects recruited for the original study, 21 schooled literate and 20 unschooled illiterate subjects matched by age and gender were eligible for inclusion in the present study (see Table 1). A total of 12 schooled literate and four unschooled illiterate subjects were excluded from the original data set. One literate subject was excluded due to stroke, one due to traumatic brain injury, one due to Parkinson’s disease, three screened positive for cognitive impairment and six screened positive for depression. One illiterate subject was excluded due to stroke, two screened positive for cognitive impairment and one screened positive for depression. The final age- and gender-matched literate and illiterate groups were created from the remaining pool of 25 unschooled illiterate and 42 schooled literate subjects.

Procedure

All included subjects completed an interview and assessment of approximately 90 minutes, including a structured demographic and health interview, screening for depression and a neuropsychological test battery. As part of this, subjects were exposed to two conditions of semantic verbal fluency; namely animal fluency and supermarket fluency (Strauss et al., 2006).
In animal and supermarket fluency, subjects were required to generate as many different animal names or “things you can buy in a supermarket” as possible within a one-minute interval. For each category, the score is the number of different items produced in one minute. The two fluency tests were always performed in the same order, beginning with animal fluency. All subjects were assessed in Turkish with assistance from an interpreter.

Acculturation was measured with a Turkish adaption of the Short Acculturation Scale for Hispanics (SASH) (Nielsen, Vogel, Gade, et al., 2012) as well as years of residence in Denmark. The SASH consists of 12 items that measure acculturation level according to three dimensions on a five-point Likert scale, namely language use, media, and ethnic social relations (Marín, Sabogal, Marín, Otero-Sabogal, & Perez-Stable, 1987). The responses can be averaged across items (range of scores is one through five) with higher scores indicating higher levels of acculturation. As in other cultural adaptations of the SASH (Choi & Reed, 2011; Dela Cruz et al., 2000), wordings such as “English” and “Americans” were changed to “Danish” and “Danes”, and “Spanish” and “Latinos/Hispanics” were changed to “Turkish” and “Turks”.

The study adhered to the Declaration of Helsinki for research involving human subjects and was approved by the Committees on Biomedical Research Ethics for the Capital Region of Denmark, and the Danish Data Protection Agency. Information about the study was presented both in writing and orally, and written informed consent was obtained from all subjects.

**Statistical analyses**

Fischer’s Exact Test or the chi-square test was used to test the significance of differences in the distribution of categorical variables. Differences between continuous variables were tested with analyses of variance (ANOVA) or the Mann–Whitney U test, when appropriate. The linear association between semantic fluency performance and age, years of residence in Denmark and SASH score was assessed using Spearman’s rank-order correlation coefficient. Interactions between semantic criterion and literacy were analyzed with a repeated measures analysis of variance with the total number of correct items as the dependent variable. To examine the possible influence of acculturation on these interactions, the analyses were repeated with years of residence in Denmark and SASH score as covariates. Effects sizes were measured as partial eta squared. All analyses were performed with SPSS statistical software (Version 19.0; SPSS Inc., Chicago, Ill., USA). A p-value <0.05 two-tailed was considered significant.

**Results**

The sample characteristics are presented in Table 1. The sample was largely constituted by females as illiteracy is less common among males who generally have obtained primary schooling. Among literate subjects, just two out of 21 had more than primary schooling (five years at the time the subjects attended school in Turkey). No significant differences were present between the literate and illiterate groups in age, the distribution of gender or in conditions potentially affecting cognitive function. However, literate subjects generally had more years of residence in Denmark ($F (1, 39) = 6.80, p = 0.013$) and higher SASH scores ($U = 148, p < 0.001$).
Performance on the animal criterion was significantly better in the literate group as compared to the illiterate group ($F(1, 39) = 12.2, p = 0.001$, partial eta squared = 0.24), whereas there were no differences between the groups on the supermarket criterion ($F(1, 39) = 11.4, p = 0.574$, partial eta squared = 0.008) (Table 1). Performance on the animal criterion was positively correlated with years of residence in Denmark ($\rho = 0.391, p = 0.042$) and SASH score ($\rho = 0.316, p = 0.044$), whereas performance on the supermarket criterion was negatively correlated with age ($\rho = -0.330, p = 0.035$). Gender did not affect performances on either criterion.

As illustrated in Figure 1, there was a significant interaction effect between the semantic criteria and literacy group ($F(1, 39) = 6.4, p = 0.016$, partial eta squared = 0.14). This interaction effect was related to a significant effect of semantic criteria within the illiterate group ($F(1, 39) = 44.8, p < 0.001$, partial eta squared = 0.54) and a strong trend for a literacy effect for the animal criterion ($F(1, 39) = 3.9, p = 0.055$, partial eta squared = 0.09). Adjusting for years of residence in Denmark and SASH score did not affect the interaction effect between the semantic criteria and literacy group ($F(1, 37) = 6.9, p = 0.012$, partial eta squared = 0.16) or the effect of semantic criteria within the illiterate group ($F(1, 37) = 45.8, p < 0.001$, partial eta squared = 0.55). However, the trend for a literacy effect for the animal criterion disappeared ($F(1, 37) = 2.0, p = 0.164$, partial eta squared = 0.05).

**Discussion**

This study compared performance of illiterate and literate immigrants on an animal and supermarket criterion for the semantic verbal fluency test and investigated how this may be related to the ecological relevance of the semantic criterion. Further, the influence of acculturation on test performances was examined.

Overall, our results are in line with previous studies comparing semantic verbal fluency in illiterate and literate people (see Table 2). In the Turkish immigrant population in present study, illiterate people produced a mean of 12.2 animal names in one minute,
Table 2. Summary of studies comparing semantic verbal fluency in literate and illiterate samples.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Socio-cultural group</th>
<th>n</th>
<th>% female</th>
<th>Age, years mean (SD)</th>
<th>Semantic fluency mean (SD)†</th>
<th>Education, years mean (SD)</th>
<th>Semantic fluency mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present study</td>
<td>Turkish (Denmark)</td>
<td>20</td>
<td>90</td>
<td>66.0†</td>
<td>Animals: 12.2 (3.9)</td>
<td>5.0†</td>
<td>16.9 (4.7)</td>
</tr>
<tr>
<td>Brucki and Rocha (2004)</td>
<td>Brazilian</td>
<td>34</td>
<td>–</td>
<td>49.4 (15.8)</td>
<td>12.1 (3.0)</td>
<td>1–4</td>
<td>13.6 (3.6)</td>
</tr>
<tr>
<td>da Silva et al. (2004)</td>
<td>Portuguese</td>
<td>18</td>
<td>100</td>
<td>66.0 (6.0)</td>
<td>Animals: 12.4 (4.2)</td>
<td>1–4</td>
<td>16.1 (3.8)</td>
</tr>
<tr>
<td>Fichman et al., (2009)</td>
<td>Brazilian</td>
<td>51</td>
<td>–</td>
<td>74.9 (6.0)</td>
<td>S-market items: 15.9 (3.0)</td>
<td>5–8</td>
<td>14.3 (3.9)</td>
</tr>
<tr>
<td>Kosmidis et al., 2004</td>
<td>Greek</td>
<td>19</td>
<td>100</td>
<td>72.0 (7.6)</td>
<td>Animal fruits and objects: 30.6 (5.4)</td>
<td>1–9</td>
<td>15.4 (4.6)</td>
</tr>
<tr>
<td>Manly et al. (1999)</td>
<td>Hispanic, African American (USA)</td>
<td>43</td>
<td>74</td>
<td>74.8 (5.7)</td>
<td>S-market items: 15.9 (3.0)</td>
<td>&gt;11</td>
<td>17.2 (4.8)</td>
</tr>
<tr>
<td>Mathuranath et al. (2003)</td>
<td>Malayalam (India)</td>
<td>22</td>
<td>47</td>
<td>66.9 (5.6)</td>
<td>Matched</td>
<td>1–9</td>
<td>40.4 (6.8)</td>
</tr>
<tr>
<td>Ostrosky-Solis et al. (1999)</td>
<td>Mexican</td>
<td>50</td>
<td>50</td>
<td>16–30</td>
<td>13.2 (4.5)</td>
<td>&gt;9</td>
<td>50.1 (9.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>31–50</td>
<td>13.7 (4.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>49</td>
<td>51</td>
<td>51–65</td>
<td>12.7 (5.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosselli et al. (1990)</td>
<td>Colombian</td>
<td>100</td>
<td>50</td>
<td>16–25</td>
<td>10.6</td>
<td>&gt;10</td>
<td>17.8</td>
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<td></td>
<td></td>
<td>50</td>
<td>50</td>
<td>26–35</td>
<td>11.2</td>
<td>&gt;16</td>
<td>17.8</td>
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<td>36–45</td>
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<td>46–55</td>
<td>11.3</td>
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<td>50</td>
<td>50</td>
<td>56–65</td>
<td>10.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Youn et al. (2011)</td>
<td>Korean</td>
<td>25</td>
<td>100</td>
<td>73.2 (60)</td>
<td>11.8 (3.1)</td>
<td>8 (2.3)</td>
<td>14.1 (3.5)</td>
</tr>
</tbody>
</table>

† Unless otherwise stated, the adopted version of semantic verbal fluency is animals within a one-minute interval.
‡ In the present study, age and education are given as median values.
which was significantly less compared to literate people, who produced a mean of 16.9 animal names. These performances are comparable to those reported in previous studies in Brazilian, Colombian, Greek, Korean, Mexican, Portuguese, and US ethnic minority populations of comparable age and education (Brucki & Rocha, 2004; da Silva et al., 2004; Fichman et al., 2009; Kosmidis et al., 2004, 2004; Manly et al., 1999; Ostrosky-Solis et al., 1999; Rosselli et al., 1990; Youn et al., 2011). An exception, however, is an Indian study that found illiterate and literate Malayalam speaking people to produce a mean of just 6 and 7.9 animal names in one minute, respectively (Mathuranath et al., 2003). In accordance with previous studies (Brucki & Rocha, 2004; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Rosselli et al., 1990), we found performance on both semantic criteria to be unrelated to gender. Previous reports on the influence of age on semantic fluency performance in illiterate and literate people have been contradicting (Brucki & Rocha, 2004; Fichman et al., 2009; Mathuranath et al., 2003; Ostrosky-Solis et al., 1999; Rosselli et al., 1990). In this study, increasing age was associated with poorer performance on the supermarket criterion but did not affect performance on the animal criterion. The observed differences between studies may reflect differences in study methods and procedures, as well as the demographic characteristics of the investigated populations. However, the observed differences are also likely to be influenced by cultural, linguistic and ethnic differences between study populations. For instance, different cultural views on the value of speed and fast performances (Arentoft et al., 2012; Ardila, 2005) and the length of words in different languages (Kempler, Teng, Dick, Taussig, & Davis, 1998) have been proposed to affect the number of words people produce in verbal fluency.

Our results also support the conclusions from the study by da Silva et al. (2004) that found literate and illiterate Portuguese women with similar socio-cultural background to perform equally well on a supermarket fluency task but to differ significantly on an animal fluency task. While performance of both literate and illiterate subjects was comparable across the two studies for the animal criterion, performances differed for the supermarket criterion (see Table 2). This difference may be explained by the fact that we adopted a more lenient criterion for the supermarket fluency task where subjects were asked to name “things you can buy in a supermarket” as opposed “food items at the supermarket” which was used in the study by da Silva et al. (2004).

Although there is evidence that early acquisition of reading and writing skills affect cognitive processes, brain development and the functional and structural organization of the brain (Carreiras et al., 2009; Castro-Caldas, Petersson, Reis, Stone-Elander, & Ingvar, 1998), we believe the associations between literacy status and semantic verbal fluency performance are mainly related to the ecological relevance of the semantic criteria. Results from previous studies suggest that the fundamental workings of semantic memory, including semantic processing and organization in semantic verbal fluency, is not dependent on literacy or exposure to formal schooling but rather reflects an innate human ability (Brucki & Rocha, 2004; da Silva et al., 2004; Kosmidis et al., 2004). Also, as previously proposed by da Silva et al. (2004), the overall similarity in performance on the supermarket criterion appears to exclude the possibility of a general factor, such as mental speed or fluency, for the differences in performance on the animal criterion. The differences between the supermarket and animal criterion are better explained by similarities and differences in access to shared semantic knowledge, which is greater
for the supermarket items and lesser for animals. While both literacy groups have primarily obtained their knowledge of supermarkets from direct experience in everyday life, the literate group has obtained a substantial part of their knowledge of animals, in particular non-native and more exotic animals, indirectly from school attendance and via written media. Thus, in line with previous studies (Brucki & Rocha, 2004; da Silva et al., 2004), literate subjects would typically name animals from within a range of subcategories, while illiterate subjects would primarily name the animals with which they were most familiar, usually animals from the village in Turkey where they grew up and from their immediate surroundings in Denmark.

In line with the only US study of acculturation and verbal fluency performance that included an immigrant sample (Arentoft et al., 2012), we found performance on the animal criterion to be related to level of acculturation and years of residence in Denmark. This is most likely because familiarity with the Danish culture and customs brings with it new experiences with animals in everyday life resulting in greater access to shared semantic knowledge of animals. Performance on the supermarket criterion, however, was unrelated to these variables and the strong associations between literacy, verbal fluency performance and ecological relevance of semantic criteria were only minimally affected by cultural experience associated with residing in Denmark and level of Danish acculturation. When considered as a group, Turkish immigrants are very heterogeneous in their socioeconomic and educational backgrounds. However, the majority of both illiterate and literate subjects in the present study were women born and raised in rural communities in Turkey where the availability of formal schooling was limited or they were required to work from an early age. In Denmark, these individuals have typically obtained manual labor jobs that did not require reading or writing skills. Thus, migrating to Denmark has been associated with little further experience or skills supporting semantic verbal fluency performance.

Limitations of the present study were the small sample size and the limited number of male subjects, which makes the generalizability of our results less certain. However, we did not find gender to affect test performances. Also, although animal and supermarket fluency have been found equally sensitive to cognitive impairment in a literate people (Monsch et al., 1992), we unable to compare diagnostic accuracy of the semantic criteria across literacy groups as we had no data on cognitively impaired individuals. Another limitation is the limited range in SASH scores, with both literacy groups having fairly low levels of Danish acculturation. This may have led to an underestimation of the influence of acculturation on the reported associations. Also, the use of a brief unidimensional acculturation measure, although practical, has a number of shortcomings. Measures such as the SASH rely on self-report and can only be considered indirect measures of the complex factors that make up cultural experience. However, the acculturation measure is well validated and previous research has successfully utilized the SASH in the same population (Nielsen, Vogel, Gade, et al., 2012; Nielsen & Jorgensen, 2013).

Finally, although all included subjects were screened for factors known to affect cognitive function and were screened for cognitive impairment with the RUDAS, we cannot rule out that some subjects may have had unrecognized mild neurological dysfunctions. Included subjects were not brain scanned and we were not able to perform formal neuropsychological assessments as no suitable Danish neuropsychological test batteries for illiterate subjects exist.
Despite these limitations, we believe that our results lend further support to the strong associations between literacy, semantic verbal fluency performance and ecological relevance of the semantic criterion and extend previous findings to immigrants with different cultural experiences related to the acculturation process. Although our study sample was constituted by Turkish immigrants, we believe that our findings represent a general issue in immigrant groups with similar educational backgrounds and migration histories.

Future research is needed to examine how the semantic criteria used for semantic verbal fluency affect classification of cognitive impairment in illiterate compared to literate individuals as this may have important implications for clinical assessments. Also, more research is required to further disentangle the associations between literacy, acculturation and neuropsychological test performance both within and across different cognitive domains.

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No potential conflict of interest was reported by the authors.

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